March 3, 1864.

Major-General SABINE, President, in the Chair.

In accordance with the Statutes, the names of the Candidates for election into the Society were read, as follows:—

Alexander Armstrong, M.D.
William Baird, M.D.
Sir Henry Barkly, K.C.B.
Henry Foster Baxter, Esq.
Sir Charles Tilston Bright.
William Brinton, M.D.
John Charles Bucknill, M.D.
Lieut.-Col. John Cameron, R.E.
T. Spencer Cobbold, M.D.
The Hon. James Cockle, M.A.
Henry Dircks, Esq.
Alexander John Ellis, B.A.
John Evans, Esq.
William Henry Flower, Esq.
Sir Charles Fox.
George Gore, Esq.
George Robert Gray, Esq.
Thomas Grubb, Esq.
Henri Gueneau de Mussy, M.D.
William Augustus Guy, M.B.
George Harley, M.D.
Sir John Charles Dalrymple Hay, Bart.
Benjamin Hobson, M.B.
William Charles Hood, M.D.
Fleeming Jenkin, Esq.
William Jenner, M.D.
Edmund C. Johnson, M.D.
Prof. Leone Levi.
Waller Augustus Lewis, M.B.
Sir Charles Locock, Bart., M.D.
Edward Joseph Lowe, Esq.
The Hon. Thomas M'Combie.
Sir Joseph F. Olliffe, M.D.
George Wareing Ormerod, M.A.
Thomas Lambe Phipson, Esq.
John Russell Reynolds, M.D.
William Henry Leighton Russell, B.A.
William Sanders, Esq.
Col. William James Smythe, R.A.
Lieut.-Col. Alexander Strange.
Thomas Tate, Esq.
Charles Tomlinson, Esq.
George Charles Wallich, M.D.
Robert Warington, Esq.
Charles Wye Williams, Esq.
Nicholas Wood, Esq.
Henry Worms, Esq.

The following communication was read:—

"On the Spectra of Ignited Gases and Vapours, with especial regard to the different Spectra of the same elementary gaseous substance." By Dr. Julius Plücker, of Bonn, For. Memb. R.S., and Dr. S. W. Hittorf, of Munster. Received February 23, 1864.

(Abstract.)

In order to obtain the spectra of the elementary bodies, we may employ either flame or the electric current. The former is the more easily managed, but its temperature is for the most part too low to volatilize the body to be

examined, or, if it be volatilized or already in the state of gas, to exhibit its characteristic lines. In most cases it is only the electric current that is fitted to produce these lines; and the current furnished by a powerful induction coil was what the authors generally employed.

In the application of the current, different cases may arise. The body to be examined may be either in the state of gas, or capable of being volatilized at a moderate temperature, such as glass will bear without softening, or its volatilization may require a temperature still higher.

In the first two cases the body is enclosed in a blown-glass vessel consisting of two bulbs, with platinum wires for electrodes, connected by a capillary tube. In the case of a gas, the vessel is exhausted by means of Geissler's exhauster, and filled with the gas at a suitable tension. In the case of a solid easily volatilized, a portion is introduced into the vessel, which is then exhausted as highly as possible, and the substance is heated by a lamp at the time of the observation. In the third case the electric current is employed at the same time for volatilizing the body and rendering its vapour luminous. If the body be a conductor, the electrodes are formed of it; but the spectrum observed exhibits not only the lines due to the body to be examined, but also those which depend on the interposed gas. This inconvenience is partly remedied by using hydrogen for the interposed gas, as its spectrum under these circumstances approaches to a continuous one. If the body to be examined be a non-conductor, the metallic electrodes are covered with it. In this case the spectrum observed contains the lines due to the metal of which the electrodes are formed, and to the interposed gas, as well as those due to the substance to be examined.

Among the substances examined, the authors commence with nitrogen, which first revealed to them the existence of two spectra belonging to the same substance. The phenomena presented by nitrogen are described in detail, which permits a shorter description to suffice for the other bodies examined.

On sending through a capillary tube containing nitrogen, at a pressure of from 40 to 80 millimetres, the direct discharge of a powerful Ruhmkorff's coil, a spectrum is obtained consisting, both in its more and in its less refrangible part, of a series of bright shaded bands: the middle part of the spectrum is usually less marked. In each of the two parts referred to, the bands are formed on the same type; but the type in the less refrangible part of the spectrum is quite different from that in the more refrangible. In the latter case the bands have a channeled appearance, an effect which is produced by a shading, the intensity of which decreases from the more to the less refracted part of each band. In a sufficiently pure and magnified spectrum, a small bright line is observed between the neighbouring channels, and the shading is resolved into dark lines, which are nearly equidistant, while their darkness decreases towards the least refracted limit of each band. With a similar power the bands in the less refrangible part of the spectrum are also seen to be traversed by fine dark lines, the arrange-

ment of which, however, while similar for the different bands, is quite different from that observed in the channeled spaces belonging to the more refrangible region.

If, instead of sending the *direct* discharge of the induction coil through the capillary tube containing nitrogen, a Leyden jar be interposed in the secondary circuit in the usual way, the spectrum obtained is totally different. Instead of shaded bands, we have now a spectrum consisting of brilliant lines having no apparent relation whatsoever to the bands before observed. If the nitrogen employed contains a slight admixture of oxygen, the bright lines due to oxygen are seen as well as those due to nitrogen, whereas in the former spectrum a slight admixture of oxygen produced no apparent effect.

The different appearance of the bands in the more and in the less refracted portion of the spectrum first mentioned suggested to the authors that it was really composed of two spectra, which possibly might admit of being separated. This the authors succeeded in effecting by using a somewhat wider tube. Sent through this tube, the direct discharge gave a golden-coloured light, which was resolved by the prism into the shaded bands belonging to the less refrangible part of the spectrum, whereas with a small jar interposed the light was blue, and was resolved by the prism into the channeled spaces belonging to the more refrangible part.

By increasing the density of the gas and at the same time the power of the current, or else, in case the gas be less dense, by interposing in the secondary circuit at the same time a Leyden jar and a stratum of air, the authors obtained lines of dazzling brilliancy which were no longer well defined, but had become of appreciable breadth, while at the same time other lines, previously too faint to be seen, made their appearance. The number of these lines, however, is not unlimited. By the expansion of some of the lines, especially the brighter ones, the spectrum tended to become continuous.

Those spectra which are composed of rather broad bands, which show different appearances according as they are differently shaded by fine dark lines, the authors generally call *spectra of the first order*, while those spectra which show brilliant coloured lines on a more or less dark ground they call *spectra of the second order*.

Incandescent nitrogen accordingly exhibits two spectra of the first, and one of the second order. The temperature produced by the passage of an electric current increases with the quantity of electricity which passes, and for a given quantity with the suddenness of the passage. When the temperature produced by the discharge is comparatively low, incandescent nitrogen emits a golden-coloured light, which is resolved by the prism into shaded bands occupying chiefly the less refrangible part of the spectrum. At a higher temperature the light is blue, and is resolved by the prism into channeled bands filling the more refrangible part of the spectrum. At a still higher temperature the spectrum consists mainly of bright lines,

which at the highest attainable temperature begin to expand, so that the spectrum tends to become continuous.

The authors think it probable that the three different spectra of the emitted light depend upon three allotropic states which nitrogen assumes at different temperatures.

By similar methods the authors obtained two different spectra of sulphur, one of the first and one of the second order. The spectrum of the first order exhibited channeled spaces, like one of the two spectra of that order of nitrogen; but the direction in which the depth of shading increased was the reverse of what was observed with nitrogen, the darker side of each channeled space being in the case of sulphur directed towards the red end of the spectrum.

Selenium, like sulphur, shows two spectra, one of the first and one of the second order.

Incandescent carbon, even in a state of the finest division, gives a continuous spectrum. Among the gases which by their decomposition, whether in flame or in the electric current, give the spectrum of carbon, the authors describe particularly the spectra of cyanogen and olefiant gas when burnt with oxygen or with air, and of carbonic oxide, carbonic acid, marsh-gas, olefiant gas, and methyl rendered incandescent by the electric discharge; they likewise describe the spectrum of the electric discharge between electrodes of carbon in an atmosphere of hydrogen. The spectrum of carbon examined under these various conditions showed great varieties, but all the different types observed were represented, more or less completely, in the spectrum of cyanogen fed with oxygen. The authors think it possible that certain bands, not due to nitrogen, seen in the flame of cyanogen, and not in any other compound of carbon, may have been due to the undecomposed gas.

The spectrum of hydrogen, as obtained by a small Ruhmkorff's coil, exhibited chiefly three bright lines. With the large coil employed by the authors, the lines slightly and unequally expanded. On interposing the Leyden jar, and using gas of a somewhat higher pressure, the spectrum was transformed into a continuous one, with a red line at one extremity, while at a still higher pressure this red line expanded into a band.

The authors also observed a new hydrogen spectrum, corresponding to a lower temperature, but having no resemblance at all to the spectra of the first order of nitrogen, sulphur, &c.

Oxygen gave only a spectrum of the second order, the different lines of which, however, expanded under certain circumstances into narrow bands, but very differently in different parts of the spectrum.

Phosphorus, when treated like sulphur, gave only a spectrum of the second order.

Chlorine, bromine, and iodine, when examined by the electric discharge, gave only spectra of the second order, in which no two of the numerous spectral lines belonging to the three substances were coincident. The

authors were desirous of examining whether iodine would give a spectrum of the first order the reverse of the absorption-spectrum at ordinary temperatures. The vapour of iodine in an oxyhydrogen jet gave, indeed, a spectrum of the first order, but it did not agree with what theory might have led us to expect.

In the electric discharge, arsenic and mercury gave only spectra of the second order. The metals of the alkalies sodium, potassium, lithium, thallium show, even at the lower temperature of Bunsen's lamp, spectra of the second order.

Barium, strontium, calcium in the flame of Bunsen's lamp show bands like spectra of the first order, and in each case a well-defined line-like spectra of the second order. On introducing chloride of barium into an oxyhydrogen jet, the shading of the bands was resolved into fine dark lines, proving that the band-spectrum of barium is in every respect a spectrum of the first order.

Spectra of the first order were observed in the case of only a few of the heavy metals, among which may be particularly mentioned lead, which, when its chloride, bromide, iodide, or oxide was introduced into an oxyhydrogen jet, gave a spectrum with bands which had a channeled appearance in consequence of a shading by fine dark lines.

Chloride, bromide, and iodide of copper gave in a Bunsen's lamp, or the oxyhydrogen jet, spectra with bands, and besides a few bright lines. The bands in the three cases were not quite the same, but differed from one another by additional bands. Manganese showed a curious spectrum of the first order. When an induction discharge passed between electrodes of copper or of manganese, pure spectra of these metals, of the second order, were obtained.

March 10, 1864.

Major-General SABINE, President, in the Chair.

The following communication was read:—

"On the Influence of Physical and Chemical Agents upon Blood; with special reference to the mutual action of the Blood and the Respiratory Gases." By GEORGE HARLEY, M.D., Professor of Medical Jurisprudence in University College, London. Communicated by Dr. SHARPEY, Sec. R.S. Received March 3, 1864.

(Abstract.)

This communication is divided into two parts. The first is devoted to the investigation of the influence of certain physical agencies, viz. simple diffusion, motion, and temperature, and of the conditions of time and the age of the blood itself. The second part includes the consideration of